U.S. Fish and Wildlife Service
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Investigation and selection of resistence board weir site locations in the Innoko River drainage, Innoko National Wildlife Refuge, Alaska, 2001

Final Report No. FIS01-048

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Final Report Summary Page

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Geographic Area: Yukon River drainage

Information Type: Stock status and trends

Issue(s) Addressed: Lack of baseline information to support federal subsistence fishery management on salmon populations within the Innoko River drainage.

Study Cost: $5,900.00 **Study Duration:** May 2001- December 2001

Abstract: A feasibility study was conducted on August 20 to survey various tributaries within the Innoko River drainage for potential weir sites. An aerial survey was the method of choice to collect the desired information. The result of a 2001 pilot radio telemetry study, conducted by Fairbanks Fishery Resource Office and Innoko National Wildlife Refuge personnel, indicated that salmon utilized tributaries in the upper Innoko River drainage. The aerial survey for this study focused on those tributaries; Dishna River, Tolstoi Creek, Ophir Creek, and the mainstem Innoko River above the mouth of the North Fork. Due to complications with logistics, early termination of Refuge field camp prevented the use of their boat, motor, and camp, our study was limited to one aerial survey and no ground surveys. The criteria for selecting possible weir sites was based on; 1) flow characteristics, 2) water depth, 3) channel width, 4) substrate size, and 5) stream bottom characteristics. Out of all the tributaries surveyed the best site location was either on the main stem Innoko River 20 km upstream of the North Fork or on the Dishna River 10 km above the mouth. Because little hydrography data have been collected from this drainage it would be advisable to conduct a pilot study, i.e. counting tower, to record water characteristics throughout the field season. The information from the pilot study would give an indication if a resistence board weir is feasible to operate.

Key Words: Yukon River drainage, Innoko River, chinook and chum salmon, spawning adults, resistence board weir.

Project Data: *Description.*—Data from this study consisted of aerial surveys, information on possible locations for installing a resistence board weir, and the number of systems within the Innoko River that have possible locations for a study site. *Format.*—Survey information is stored

Microsoft Excel and report information in Wordperfect 9 database. *Custodians.*—Survey data and reports are maintained by U.S. Fish and Wildlife Service, Fairbanks Fishery Resource Office, 101 12th Avenue, Room 222, Fairbanks, Alaska 99701. *Availability.*—All other information collected in conjunction with this study is available upon request to the custodian.

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Executive Summary: Salmon populations *Oncorhynchus spp.* within the Yukon River drainage have shown a steady decline since the mid 1980's. Over the past 20 years various state, federal, and private agencies have conducted studies and collected biological data from salmon populations migrating to tributaries along the Yukon River. Due to the expansive nature of the Yukon River drainage, it is unfeasible to collect data from all tributaries.

A major tributary that shows potential for salmon production is the Innoko River in the Innoko National Wildlife Refuge. Of the 3.8 million acres of land within the Innoko National Wildlife Refuge, roughly 28,230 km^2 is drained by the Innoko River. This watershed is characterized as a lowland river system containing complex streams, lakes, and interconnected sloughs. There are a number of tributaries that flow into the Innoko River with the major ones being the Iditarod, Dishna, Yetna, Mud, and the North Fork Innoko Rivers.

Results from studies have documented salmon presence within the Innoko River drainage. Specifically, salmon have been recorded utilizing the Iditarod, and Dishna Rivers, and mainstem Innoko River above the mouth of the North Fork. Unfortunately, no biological data have been collected from these salmon stocks regarding distribution and relative magnitude. The need for this baseline information is required to efficiently direct future monitoring efforts. In addition, the Eastern and Western Interior Regional Advisory Councils have documented the need to; "identify spawning populations of salmon and their run sizes in the Yukon River drainage", "assess the production and contribution of salmon from clear water streams in the lower Yukon to the overall salmon run", and "identify the contribution of different salmon populations to the fisheries in the Yukon Rive drainage." There are multiple phases in collecting biological information from specific salmon stocks within different river systems. A 2001 pilot radio telemetry study was the first phase in collecting the distribution pattern of chinook and chum salmon in the Innoko River. The result of that study showed that by tagging small numbers of salmon with radio transmitters the location of spawning areas can be recorded. The second phase, which is covered in this report, is to survey these systems for possible study site locations. The third and fourth phase of this objective, which are not covered in the scope of this report, would be to determine which tributary supports the most abundant salmon populations and to set up monitoring projects on those systems.

One of the objectives of the 2001 pilot radio telemetry study was to estimate the proportion of salmon spawning in various tributaries of the Innoko River. The result of that study showed that 18 of the 20 transmitters implanted in salmon migrated upstream. One transmitter was disgorged and the other transmitter was not relocated. All 18 tagged salmon migrated to the upper reaches of the Innoko River drainage. The distribution of the 18 tagged salmon ranged from the Iditarod River to the mainstem Innoko river above the North Fork. Specifically, 2 chum salmon migrated into the Iditarod River, 5 chum salmon and 1 chinook salmon migrated into the Dishna River, and 10 salmon migrated up the mainstem Innoko River above the Dishna River.

Using the information from the pilot radio telemetry study, an objective for our study was formulated. The objective of our study was to conduct surveys to record possible weir site locations. An aerial survey was conducted on four major tributaries which were the; Dishna River, Tolstoi Creek, Ophir Creek, and mainstem Innoko River above the mouth of the North Fork. In an attempt to meet this objective a plane was chartered from a Galena business to conduct the survey.

The aerial survey was only able to partially meet the objective stated for this study. The investigational plan was designed to make multiple trips to the Innoko River drainage throughout the

summer to conduct aerial and on-the-ground surveys. Unfortunately, personnel problems surfaced within the Refuge office that caused their field season to be cut short and their base camp to close early. The early breakdown of camp prohibited the use of one of the boats needed for the ground survey.

The results from the aerial survey and the criteria for selecting a weir site (flow characteristics, water depth, channel width, substrate size, and stream bottom characteristics) provided two possible weir site locations. The first site is located on the main stem Innoko River, 20 km upstream of the mouth of the North Fork and the second site is located on the Dishna River, 10 km upstream of the mouth. There were suitable sites on the other systems surveys but their location was above salmon spawning areas. Additional information was collected on the two possible areas through communication with the Innoko National Wildlife Refuge and U.S. Fish and Wildlife-Fairbanks Fishery Resource Office personnel. This information indicated that during low flows these areas have channel characteristics with alternating pools and riffles. Even though discharge was not measured, the water velocity during low water level would not hinder the placement of a weir.

The problem with installing a weir at either site is the location. Trying to get weir materials and supplies to either site would be the biggest problem. A major contributing factor is river and ice conditions during spring breakup. If the river is ice free late in the season, as it was in 2001, then the materials and supplies might not arrive in time to assemble and install the weir. A more logical alternative to installing a weir would be to conduct a counting tower pilot study. The amount of materials and supplies need to conduct this type of study is greatly reduced thus lessening transport complications. The information from this type of study would record the proportion of salmon migrating into the system and water characteristics. Analysis of the data collected on hydrography would provide insight as to whether operating a weir was feasible or not. Studies have been conducted on the feasibility of a counting tower for estimating salmon escapement. Results from both studies indicate that salmon estimation can be accomplished by counting portions of the hour and still get a good representation of the escapement with little error involved.

Introduction

Chinook *Oncorhynchus tshawytscha*, chum *O. keta*, and coho *O. kisutch* salmon stocks comprise the majority of subsistence and personal use harvest of villagers living along the Yukon River drainage. To be effective, management of the Yukon River fishery, there is a requirement for the knowledge of the number of salmon harvest by the subsistence and personal users (Borba and Hamner 1999). To date, state and federal agencies base their yearly management strategies, preseason forecast, in-season monitoring studies, and post season escapement estimates, on the more productive systems. In the Yukon River these systems include the Anvik, Andreafsky, Koyukuk, Chandalar, Chena, Salcha, and Tanana Rivers (Sandone 1994).

Salmon populations within the Yukon River drainage have shown a steady decline since the mid 1980's. Over the past 20 years various state, federal, and private agencies have conducted salmon related projects along the Yukon River drainage. Due to the expansive nature of the Yukon River drainage, it is unfeasible to collect escapement estimates from all tributaries. However, a major tributary that shows potential as a location for a salmon production monitoring project is the Innoko River in the Innoko National Wildlife Refuge (Refuge) (Figure 1).

The overall management goal of the U.S. Fish and Wildlife Service - Fairbanks Fishery Resource Office (USFWS-FFRO) is to collect salmon escapements from systems that would best describe the Innoko River drainage population. While there is an informal recommendation (Flannery and Miller, informal trip report) for possible weir sites, the first phase of the management goal was to conduct an in depth feasibility study to index weir sites. The second and third phase of this goal, which are not covered in the scope of this study, would be to determine which tributaries support the most abundant salmon population and to set up monitoring projects on those systems.

While there is documentation of salmon presence within the Innoko River drainage (Millard 1995, Alt 1985, Flannery and Miller, informal trip report 1996, Brown in preparation) and there is specific concern for the lack of baseline information collected from salmon stocks within the Refuge boundaries. The baseline data of these stocks is needed to efficiently direct future monitoring efforts (Millard 1995). In addition, the Eastern Interior/Western Interior Regional Advisory Councils have documented the need to: "identify spawning populations of salmon and their run sizes in the Yukon River drainage"; "assess the production and contribution of salmon from clear water streams in the lower Yukon to the overall salmon run"; and "identify the contribution of different salmon populations to the fisheries in the Yukon Rive drainage" (Fisheries Information Services 2000). The first step in meeting these obligations within the Refuge are to conduct surveys by USFWS-FFRO personnel for possible weir sites. In addition, results collected from a pilot telemetry study conducted by Brown (USFWS in preparation) will help to identify tributaries with spawning populations.

Study Area

The Innoko River is the major river system within the Refuge. Of the 3.8 million acres of land within the Refuge (USFWS 1993), roughly 28,230 km^2 is drained by this river system (Alt 1985). The headwaters of the Innoko River originate in the Kuskokwim Mountains and flows northeast then southwest to the Yukon River (USFWS 1993). There are a number of tributaries that flow into the Innoko River and the major ones are the Iditarod, Dishna, Yetna, Mud Rivers, and North Fork Innoko River (Figure 1). The Innoko River watershed is characterized as a lowland river system

containing complex streams, lakes, and interconnected sloughs (Alt 1985, USFWS 1993). The lower section of the river is slow moving with wide meandering bends. This system has the same flow characteristics of many systems of interior Alaska with high water levels during spring and intermittently during summer due to localized storms.

Objectives

The objective of this study was to survey four tributaries; Dishna River, Tolstoi Creek, Ophir Creek, and the mainstem Innoko River above the mouth of the North Fork to index possible weir site locations.

Methods

Prior to identifying potential weir sites, 20 radio transmitters were used to track the migratory path of chinook and chum salmon in the Innoko drainage. The inclusion of these transmitters were to assure that tributaries with spawning populations were surveyed for weir sites and to reduce the amount of time needed to find the spawning sites. Base funds from USFWS-FFRO and Refuge offices paid for the transmitters, relocation flights and associated salaries during transmitter implantation and relocation trips. During the relocation flight general characteristics for locations of weirs were noted, but these flights focused on relocating fish and not on identifying weir sites.

An aerial survey was conducted on tributaries of the Innoko River drainage to find a site suitable for a resistence board weir. This survey was conducted to record river characteristics that would be optimal for a resistence board weir. The criteria for selecting possible weir sites was based on; 1) flow characteristics, 2) water depth, 3) channel width, 4) substrate size, and 5) stream bottom characteristics. The survey was conducted by flying upstream and possible weir site locations were recorded on topographic maps.

Results

The pilot radio telemetry study attempted to implant 20 radio transmitters in chinook and chum salmon in the lower Innoko River drainage. Eighteen out of the 20 transmitters were relocated. One transmitter was disgorged and the other transmitter was not found. Of the remaining 18 transmitters, one was implanted in a chinook salmon and 17 implanted in chum salmon. The telemetry flight was conducted in late July to record salmon movement into the upper tributaries. All 18 salmon tagged migrated upstream of the tagging site. The telemetry aerial survey recorded 2 chum salmon in the Iditarod River, 5 chum and 1 chinook in the Dishna River, and 10 chum salmon in the mainstem Innoko River above the mouth of the North Fork (Figure 1).

Using the result of the pilot radio telemetry study an aerial survey to identify potential weir sites was conducted on August 20 in areas containing salmon. The water level in the lower Innoko River drainage was above high water level stage. The high water made it difficult to view substrate and hydrography characteristics in the lower reaches of the mainstem Innoko River and

the Dishna River. However, the upper portions of the mainstem Innoko river and the Dishna River had low water levels which allowed substrate and hydrography characteristics to be viewed.

According to the criteria, mentioned above, the most favorable area is located on the Dishna River 10 km upstream of the mouth with the Innoko River (Table 1). The second area is located on the mainstem Innoko River 20 km upstream of the mouth of the North Fork (Table 1). The other systems that were surveyed ranked low because they were above salmon spawning areas (Table 1).

Discussion

Survey methods

Following the investigational plan it was planned to make multiple trips to the Innoko River drainage throughout the summer to conduct aerial and on-the-ground surveys. Unfortunately, the Refuge base camp was closed early and thus prevented the use of their gear for the ground surveys. Also, there was only one aerial survey conducted, on August 20, due to lack of pilots from the Koyukuk and Innoko National Wildlife Refuge offices. Scheduling problems surfaced with the private carrier in Galena and August 20 was the only available date for the survey.

Site selection criteria

All four sites that were surveyed contained potential weir sites. The Dishna River was the most probable site due to three criteria; distance from the Refuge cabin, proportion of salmon migrating into that area, and hydrography characteristics.

Distance.—The Refuge office arranges for a seasonal barge to make a trip to their base camp, so all weir materials and supplies could be transported to that point. The distance from the Dishna River site to the Refuge cabin is about 79 km which would take about 2-3 hours to travel by boat. To transport all materials to the Dishna River site would take 3-4 trips. Therefore the total time needed to transport all weir materials and supplies to the study site would be 1-2 days. The second most probable site is on the mainstem Innoko River upstream of the mouth of the North Fork, which is 170 km from the Refuge cabin. The time needed to travel this distance is about 5-6 hours. Therefore making multiple trips to get the weir materials and supplies to this study site would be 3-4 days and thus result in high fuel costs. It is recommended to use the Dishna River site because it is closer to the Refuge cabin.

To compensate for boat travel another option would be to use a helicopter or fixed wing float plane, but from past experience transporting the weir material and supplies would also take multiple trips. Therefore the use of a helicopter would also be economically unfeasible and the terrain is not favorable for a float plane.

Proportion of salmon.—An optimal study site would be located in an area that had the highest proportion of salmon migrating past it. The result from the pilot radio telemetry study showed that the mainstem Innoko River upstream of the North Fork had the highest proportion of salmon, 10 out of 16. Even though there was a higher proportion of salmon migrating into the mainstem Innoko River, there was a moderate proportion of salmon migrating into the Dishna River.

Operating a weir on the Dishna River would record a good proportion of the total run size in the Innoko River drainage. Even though there was salmon present in Tolstoi and Ophir Creeks these areas are not recommended as potential sites because the magnitude of salmon spawning, based on the telemetry study, in these areas are small.

Hydrography characteristics.—In order to adequately recommend a feasible study site water characteristics need to be optimal. Unfortunately, during the aerial survey the water level was high and the water clarity was turbid. Due to these conditions not being optimal the decision for selecting a study site was based on past studies. There is documentation (Millard 1995, Miller and Flannery, informal trip 1996, Brown, in preparation) that flow during low water level would not hinder the placement of a weir.

Alternate study project

A more logical alternative to installing a weir would be to conduct a counting tower pilot study. The materials, supplies, and transportation logistics to operate a counting tower is greatly reduced compared to the materials and supplies used for a weir. A counting tower pilot study would record proportions of salmon movement in the system. Also, water flow and depth at the study site would be recorded throughout the season which would give an indication if a weir was feasible, and other sites on the river could be evaluated while the tower crew was on the ground. Results from other studies (Seibel 1967, VanHatten 2000) have shown that salmon estimation can be accomplished by counting portions fo the hour and still get a good representation of the population.

Conclusion

Information collected from salmon stocks within the Yukon River drainage is vital to understanding the biological and physical characteristics salmon go through during their life cycle. By conducting this study and the results from the pilot radio telemetry study it was found that salmon utilize the upper reaches of the Innoko River drainage and there are good sites that could be used for operating escapement enumeration projects.

The results from this study have shown that there are positive and negative aspects of installing and operating a weir in the Innoko River drainage. They are: 1) the study was only partially successful because on-the-ground surveys could not be done, 2) several likely sites were identified; the upper main stem Innoko River, Dishna River, Ophir and Tolstoi Creeks, 3) the best site was located on the Dishna River 10 km above the mouth with the Innoko River, and 4) to reduce costs and assure that the best site will work for a weir, a counting tower should be operated to collect data for several years and identify the feasibility of operating a weir at the site.

Recommendations

1. Conduct a pilot escapement study for the entire field season at the Dishna River site. For example a counting tower would be a small, in terms of material, study that could be used to get an idea of the magnitude of the salmon run. In addition, during the course of the study water characteristics would be recorded throughout the field season, and other sites could be evaluated on the ground.
2. Using the results from this and other studies, it is recommended that the study site on the Dishna River be the priority site and the site on the mainstem Innoko River above the mouth of the North Fork be the secondary site.
3. It is recommended that partnership with the Innoko National Wildlife Refuge personnel be continued, along with consultations with tribal council members from the surrounding villages.

Acknowledgments

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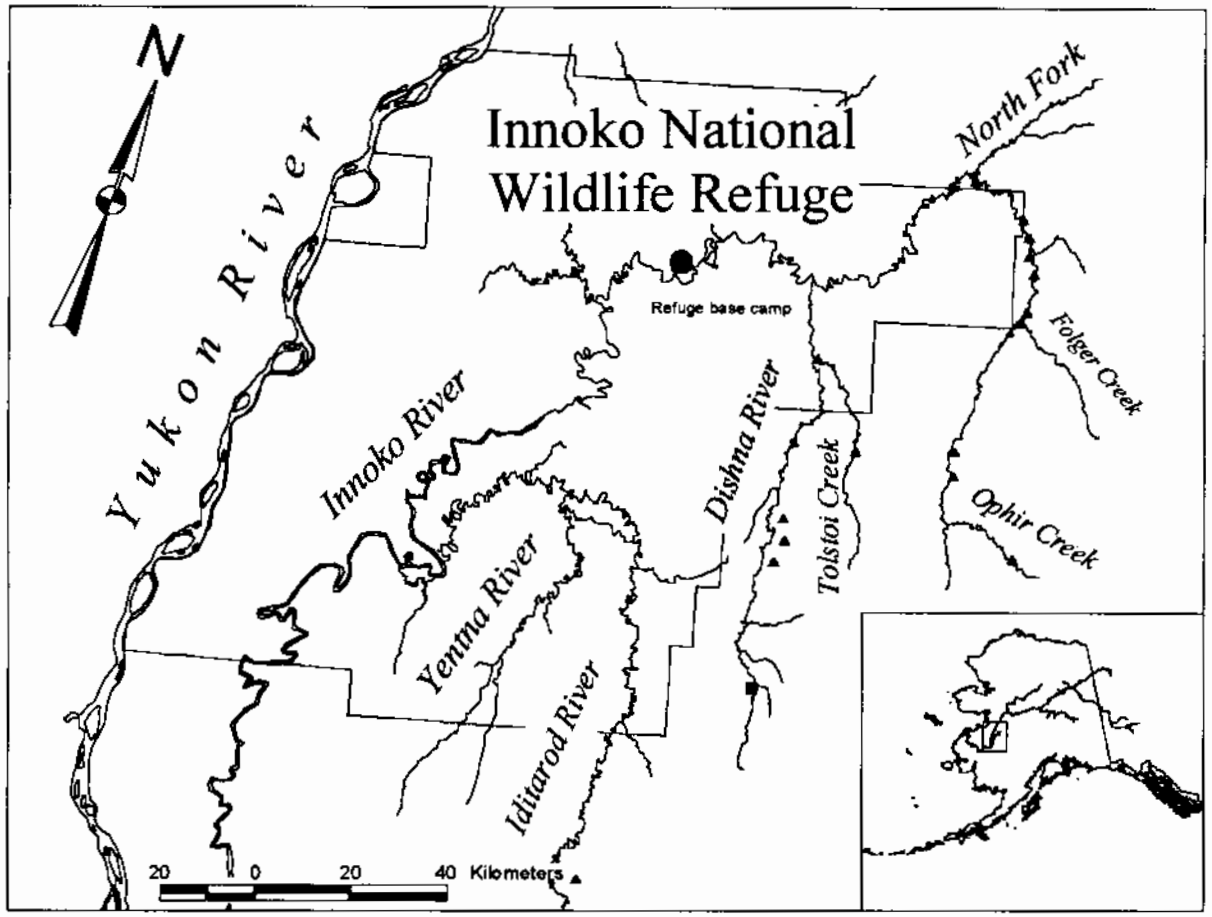

Figure 1.—Locations of radio tagged chinook and chum salmon distributions within the Innoko River drainage, Innoko National Wildlife Refuge, Alaska, 2001. Triangles represent locations of chum salmon and boxes represent locations of chinook salmon. The circle represents the Refuge base camp.

Table 1.—Latitude (Lat), longitude (Long), flow characteristics, and substrate description of potential weir sites in the Innoko River drainage, Innoko National Wildlife Refuge, Alaska 2001.

Ranking	Site	Distance from refuge cabin (km)	Lat (N)	Long (W)	Flow	Width
1	Dishna River	79	63° 34' 04"	157° 12' 35"	Parallel	100 m
2	Innoko River	170	63° 47' 34"	156° 32' 15"	Parallel	120 m
3	Tolstoi Creek	106	63° 27' 34"	157° 09' 30"	Parallel	35 m
4	Ophir Creek	265	63° 09' 45"	156° 06' 15"	Parallel	25 m

Ranking = 1 most favorable and 4 least favorable

Remarks:
Depth and stream bottom characteristics are unknown due to no ground surveys. The water level was at or near flood stage along the lower sections of the Dishna River and the mainstem Innoko River above the mouth of the North Fork. Water clarity was poor at these locations but as we flew upstream the clarity started to improve. Around the mouth of Tolstoi and Ophir Creeks the clarity was good enough to see the bottom and record substrate type.